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*Technique de psychologie expérimentale de Toulouse, Vaschide et Piéron.*  
Par E. TOULOUSE et H. PIÉRON. Paris, O. Doin et Fils, 1911. Two  
vols. pp. 303, 288.

This is the second edition, carefully revised and largely extended, of a one-volume work published by Toulouse, Vaschide and Piéron in 1904. In its original form, the *Technique* was practically a manual of mental tests, the sublimated result of ten years of teaching and investigation; it grew out of Toulouse's study of Zola (1896), where the need for precise methods was keenly felt. The authors accordingly made a clean sweep of experimental tradition, and started out to devise, on their own behalf, rules for the *examen des sujets* (see this JOURNAL, xvi., 1905, 139). The new two-volume work has a wider scope; "it allows a very large place to the methods customarily employed in the various laboratories of France, Germany, England and the United States of America;" it devotes a chapter to the doctrine of averages and the formulæ of correlation; it pays special attention to the 'higher processes;' it describes new experiments (especially in the domain of visual perception) and new apparatus; finally, it omits the theoretical framework of the earlier exposition, and so gains space for maxims of actual laboratory practice.

Nevertheless, the reader who turns to the book with the expectation of finding in it a monographic review of the methods of experimental psychology will be sadly disappointed. There is not a single reference that extends beyond the bare name of a writer, and the bibliographical index contains only four works, the manuals of Judd, Myers, Sanford and Titchener. There is no discussion of method proper: the methods of experimental psychology "are implied in our technique, but the man of science uses methods, and it is the philosopher who reflects upon them after the event and appraises or judges them; so that this is not our business." Unfortunately, the methods implied in the technique are of an empirical and proximate kind; the trail of the mental test is still apparent. However, the value of the book, at any rate to the American psychologist, is found precisely in its limitations. It has the qualities of its defects: it shows us what a course in experimental psychology becomes when the primary interest of the instructors is in individual psychology, and when the practical application of laboratory results is a constant motive in the shaping of the experiments.

As a paradigm of the writers' treatment we may take the first section of the work, the seven and a half pages allotted to Sensations of Pressure. The student is warned, at the outset, that the experiment is concerned, not with the limen of duality, but with the single sensation of contact; nothing is said of the nature of the sensation. A brief account is given (with figure) of von Frey's hair æsthesiometer. Then follows a longer account (with figure) of the haphæsthesiometric needle-points of Toulouse and Vaschide; von Frey's formula for tension values is stated in a foot-note. Beaunis' æsthesiometric needle-point is figured and described, at the expense of a page and a half, although it is difficult of manipulation, too heavy for the lower limens, and 'has hardly ever been employed.' So we come to the paragraphs headed *Technique*. A circle of at most 2 mm. in diameter is marked with a rubber stamp on the front surface of the observer's wrist, where there is no hair. The observer's eyes are blindfolded, and his hand placed in a fixed position on a felt-covered table. He is instructed that he will be touched from time to time on the back (!) of the wrist, and that he is to say Yes whenever he feels the pressure. Rate, order of touches and blank experiments, ready-signal, form of enquiry for the experimenter, are all prescribed. The series is ascending, from light to heavy; when the observer says Yes, the point evoking this response is to be used in a special series, consisting about one-half of actual touches and one-half of blanks; if the reply is always correct, the next lighter point is taken. Thus one obtains either the limen of certainty or a lower limen of

arbitrary value (touch sensed in three-quarters or less of the cases). Pauses must be made, in order to the avoidance of fatigue. Preliminary experiments are required, that the observer may understand the problem. The point must be applied slowly and in a strictly vertical position; it must remain on the skin for a constant period of time. All points must be kept, during the experiment, in a dry-chamber of 38° temperature.—Here is no lack of details; and yet the account of the experiment leaves much to be desired. At what place within the circle of 2 mm. diameter is the point of  $\frac{1}{10}$  mm. diameter to be set down; always at the same spot or indifferently at any place within the circle? How is the hand of the observer to be 'immobilised' upon the felt-covered table? Even if the method employed—an ascending series, interrupted by blank experiments—does not call for explanation and justification, why is not a descending series taken, and the two results averaged (this procedure has been recommended in the Introduction, p. 23)? What meaning will the student attach to the technical term *seuil*, when its value may be correspond to 100% of right cases, to 75%, to 'a lesser number,' or (p. 20) to four successive right answers? Are the limens obtained by the various members of the class to be averaged, whether or not they chance to be derived from pressure-spots? These and similar questions must be answered, if the experiment is to be taken in psychological earnest.

Finally, what of the instrument used? The hair *æsthesiometer* is rejected, partly on account of the hygroscopic properties of the hair, partly on account of the variation (presumably as the result of bending) of its stimulus-value. We have, instead, the *haphiæsthesiometric* needle-points of tempered steel. We are warned, however, that the manipulation of these points is by no means easy. The holder is small, oftentimes very small; too sudden an application brings the head of the needle against the roof-plate of the holder; an application in any but an exactly vertical position means friction of the needle in the guide, so that the experimenter must rest his elbows solidly on the table, fixate the head of the needle, and follow its course from various points of view; the points must be kept in the dry-chamber, at a certain temperature, or a temperature sensation will precede or accompany the sensation of contact; and the heavier points (this caution would hardly have been given had not experience proved it necessary) are liable to rust. The reviewer has had no experience with the *haphiæsthesiometer*, but on general principles he must believe that the use of the points calls for the constant supervision of the instructor, and in particular that the error arising from friction is serious. If the authors are absolutely determined against the introduction into the laboratory of 'capillary organic matter,' and if the experiment requires stimulus-points of minimal diameter, it would seem better to have recourse to Thunberg's standardized glass 'hairs.'

All these criticisms carry a single moral: that the experiment of experimental psychology is one thing, and the mental test another. In psychophysics the limen must be rigorously defined; for test purposes, an arbitrary limen may be set up, to meet the special conditions of the tests. In the psychological laboratory, the choice of method and apparatus is determined by scientific reasons and by these alone; in the case of mental tests, it is influenced by other considerations,—simplicity, ease of manipulation, portability, quickness of application and of calculation. It seems that in this first experiment, on pressure, the authors of the work under review have fallen between the two stools: their method is unduly rough, and their instruments are too delicate for any but the most skilled and careful use.

The reviewer, however, wishes to bring out the qualities of the two volumes; and this end can, perhaps, best be accomplished by way of a complete synopsis of their contents. Pt. I. discusses the measurement of the elementary phenomena of sense. Ch. i., on the measurement of cutaneous

sensations, opens with (1) the experiment on sensations of pressure which has just been described. Sensations of temperature (2) are measured by means of a thermoæsthesiometer, which deposits on the skin drops of warmed or cooled water. Kiesow's cone is figured. Sensations of pain (3) are obtained by the compression, in a pincers-like algoæsthesiometer, of a fold of the skin; the direct-pressure instruments of Macdonald and Chéron are figured. Sections follow on (4) the electrical sensations (!) produced by faradisation of the skin, and (5) miscellaneous cutaneous sensations,—caustic sensations, due to the application of caustic potash in various strengths of solution; sensations of traction; pilary sensations; sensations of tickling. Finally, directions are given for the determination (6) of the duration of cutaneous sensations (method of intermittent stimuli). Ch. ii., on the measurement of the subcutaneous sensations, is devoted to (1) sensations of vibration, evoked by the tuning fork, and (2) kinæsthetic or, as the authors prefer to call them, kinesis sensations. The latter are of three kinds: sensations of muscular effort (myoæsthesiometer: a set of holders and weights), static sensations (schesiæsthesiometer: an adjustable support for the hand, whereby positions of the arm may be varied and reinstated), and dynamic sensations of passive and active movement (schesiæsthesiometer, moving car; boards with grooved patterns, moving car). Ch. iii. brings us to the measurement of sensations of taste and smell. The instruments recommended are the geusiæsthesiometer (geusiæsthesiometer?), a set of flasks containing standard solutions, with droppers inserted in the corks, and the osmiæsthesiometer, a set of wide-mouthed bottles containing 34 aqueous solutions of camphor, of known degrees of concentration, 10 typical scents (for recognition), and 5 strengths each of liquid ammonia and of aqueous sulphuric ether (for testing the tactual sensitivity of the mucosa). Ch. iv. deals with the measurement of visual sensations. Two experiments fall under the heading (1) sensations of light. The *minimum perceptibile* is determined by an instrument constructed on the principle of Charpentier's photometer; the source of light is controlled by the Blondel-Broca photometer. Bouguer's and Blondel's diaphragms are figured. The differential limen is determined either by a differential photoæsthesiometer built on the same principle (rays from a single source are directed by two total-reflection prisms upon diffusing screens, which are viewed through tubes containing a diaphragm) or by rotating discs. (2) Sensations of color have four experiments. For the absolute limen of color, and for the differential limen of chroma ('color intensity'), the authors recommend a chromatoæsthesiometer, made up of colored solutions in rectangular glass vessels; directions are given for the preparation of the solutions. The extreme limits of color sensitivity are fixed by reference to a spectrum. The differential limen of hue is spectrometrically determined. The equation of tint, in the determination of the differential limen of chroma,—a precaution neglected in the initial experiment,—may be effected, though only at the cost of much labor, by suitable combinations of the colored solutions; it is better, therefore, to have recourse to rotating discs; these then permit also of the determination of the absolute color limen, under the same conditions; they permit, further, by the addition of increments of black or white, of the determination of the differential limen of *nuance* (*nuances claires* and *nuances foncées*, that is, changes of tint involving at the same time changes of chroma. Nothing is said of the equation of tint and chroma as a preliminary to the finding of the differential limen of hue.) (3) Visual acuity is measured by a set of optotypes, resembling those of Sulzer, (4) and the extent of the field of vision by Polack's perimeter. (5) The duration of visual sensations (method of intermittence) may be ascertained either by rotating discs (Pierre Janet's arrangement, with regulator and counter) or by Michotte's tachistoscope. Ch. v. deals with the measurement of auditory sensations. (1) The acousiæsthesiometer (drops of water fall upon a sloping plate of

aluminium which gives the  $a$  of 217.5 vs.: apparently, the authors count in complete vibrations) takes the place of the more familiar acoumeters. (2) The lower limit of pitch is found by the siren; the upper limit by Koenig's cylinders or the Galton whistle; the differential limen by forks of variable pitch. (3) The temporal limen of tone is also found by the siren; the duration of tonal sensation by means of Sanford's pendulum and tuning fork. Ch. vi. describes the measurement of the labyrinthine sensations. (1) Sensations of rotation require a turn-table, (2) sensations of translation a car running upon rails.

Pt. II. discusses the measurement of the complex phenomena of sense. Ch. i., on the measurement of the perceptions connected with cutaneous sensations, opens with experiments on (1) the cutaneous space-sense. Here we have four main experiments, the first of which, on the differentiation of contacts, has three subdivisions: the distinction of simultaneous contacts (haphæsthesiometric compasses of the writers, and of Michotte), the spatial distinction of successive contacts, and the spatial discrimination of two points, the one of which is fixed, while the other is moved away from it at a uniform rate (Michotte). Then follow experiments on the localisation of a contact, absolute or relative; on the various movement limens (kinesimeter with horse-hair stimulator); and on the cutaneous perception of form (stereoæsthesiometer). (2) The stereognostic perception of form is determined by means of a series of copper balls varying from sphere to ovoid; the forms are rolled between thumb and finger tips (dynamic stereoæsthesiometer). (3) The perception of the position and movement of the body is effected by a vertical tilt-board (somatic perception of the vertical) and an adjustable swing (perception of displacement in the vertical direction). (4) The concluding experiment measures the illusion, with passive pressure, of open and filled space. Ch. ii. takes up the perceptions connected with associated visual sensations. (1) The perception of depth is studied by means of luminous points in a dark room. (2) Five experiments are grouped under the heading of perception of magnitude: the discrimination of the lengths of horizontal and vertical lines; of the relative position of two points within a circle (the one point is fixed, the other is radially and angularly variable); of angles of different magnitudes; and of the areas of circles and squares. (3) The perception of form may be measured either by the solid forms of the stereoæsthesiometer, or by way of series of plane figures, in which the circle changes to the ellipse or the square to the oblong. (4) The movement limens are determined by the aid of luminous points in a dark room. (5) A few typical phenomena of stereoscopic vision are observed, with and without the Brewster prisms. (6) The time of perception is roughly measured by a simple form of tachistoscope (photographic shutter). The concluding experiments are devoted (7) to some typical geometrical illusions (length of lines, magnitude of areas, direction of lines) and (8) to the size-weight illusion. Ch. iii., on the measurement of perceptions connected with associated auditory sensations, comprises a single experiment, on the localisation of sound (the acousæsthesiometer is employed). Ch. iv. describes two experiments on the measurement of perceptions connected with associated sensations of diverse modalities. (1) The sense of time requires somewhat elaborate apparatus: the authors describe a new-pattern electric chronoscope (vol. ii., p. 31), fitted with Piéron's interrupter. Short, moderate and long times (*e. g.*, times of 150, 600 and 2,400  $\sigma$ ) are limited by impressions of light (Plücker's tube) or sound (bell). (2) The sense of rhythm is studied by means of notched discs actuating an electric interrupter. Ch. v. brings us to the measurement of sensory attention. (1) The difference between surprised, reflex and voluntary attention is measured by the brief exposure, in a dark room, of a series of objects presented for recognition,—without signal, with a flash of light given 0.02 sec. before illumination, and with a preparatory 'Attention!' (2) The reinforcement of sensory intensity is

shown by the lowering of the differential limen (Michotte's movement-limen, determined as in ch. i., compared with the same limen under simple distraction), by sustained precision of perception with monotonous repetition of stimuli (special form of the cancellation test), and by the fluctuation of a liminal stimulus (acousiæsthesiometer). (3) The acceleration of mental processes in attention is proved by experiment (1) as just described, and by change in the duration of simple and choice reactions. (4) The fluctuations of attention are indicated by the mean variation of the reaction times. Ch. vi., on the measurement of sensory affectivity, recommends experiments by the serial method or the method of paired comparison on colors and tones, taken singly or in groups of simultaneous or successive terms.

Pt. III. discusses the measurement of phenomena of objectification. A subjective experience may be objectified in two ways: by stimulating to a motor reaction, which produces consequences in the external world, and by arousing an affirmation of external existence. The second or affirmative mode of objectification is treated in ch. i. (1) Assurance of testimony is measured by the familiar test-picture and questionnaire. (2) Suggestibility is measured, in the same experiment, by the addition of suggestive questions, and (on its sensory side) by the subjects' liability to an illusion of warmth. Ch. ii., on the motor mode of objectification, opens (1) with an account of the apparatus required for the reaction experiment; we have already noticed the new electric chronoscope, run by a 50 or 100 vs. electric fork; the authors' complete set of instruments for visual, auditory and cutaneous reactions is shown on p. 39. (2) Rate of voluntary movement is measured by a simple tapping test and by a sorting test. (3) Accuracy of movement is measured, most simply, by a tracing test; with sensory-motor adaptation, by an aiming test; symmetrically by rectilinear arm-movements across a vertical surface. (4) Motor fatigue and the fluctuation of voluntary effort are studied by the dynamograph or ergograph. (5) Motor suggestibility is measured by Binet's belted wheels; tendency to involuntary movement by one or other of the familiar instruments: the observer is instructed to inhibit all movement when a certain word appears in a list read out to him, and the instruction has a positively suggestive effect. (6) The limits of voluntary movement are determined by instruction to move the nostrils, ears, etc., and by experiments in free stereoscopy. (7) Motor inhibition is approached by way of the reflex wink and the knee-jerk; the authors figure a special reflexometer for the measurement of the patellar reflex.

Pt. IV. discusses the measurement of intellectual phenomena; ch. i. is devoted to memory. (1) The memory of elementary perceptions may be determined by the method of recognition, with all forms of sensory technique; a uniform interval of 1 min. is prescribed. (2) Special tests are outlined for the memory of complex perceptions: kinesic memory is investigated by means of tracing-forms; auditory memory by musical tones, triads, arpeggios, and melodic fragments (the material used is given in an appendix); visual memory by combinations of curved and straight lines, by pictures of simple objects, and (as memory of attitude and expression) by observation of an artist's lay-figure. This last test seems to the writer to be worthy of introduction into American laboratories. Memory of physiognomy and of complex scenes is tested by means of paired pictures, the members of the pair differing in slight details; the use of picture post-cards is recommended. Five experiments are described under the heading (3) verbal and intellectual memory. A preliminary section deals with the manner of presentation of the material; a simple exposure-screen, with two openings for alternate use, is figured. The experiments—or rather tests—are concerned with the memory of letters and figures, of words and syllables, of phrases, and of ideas (meanings), and with types of memory; samples of material are given in an appendix. The tests present

nothing new; and we therefore pass to (4) the tests of acquisition. These are merely outlined, under the headings: time of learning (nonsense syllables), economy of learning (optimal interval; partial *vs.* global learning), the influence of fatigue, the mutual influence of the perceptual elements (series of words with first or last syllable identical, etc.), and motor apprenticeship (typewriting with change of keys). (5) The phenomena of forgetting are examined in two ways: by increase of the interval elapsing between impression and recall, and by counting the repetitions necessary for the rememorising of a forgotten syllabic series. (6) A final experiment is devoted to the phenomena of localisation, *i. e.*, the reproduction of a presented temporal or spatial order. Ch. ii. deals with the measurement of the phenomena of association. Here we have (1) experiments on free association; rate is measured by the reaction time of the single association, wealth of ideas by the number of associations effected in a given time; the forms of connection may be classified as intellectual, verbal, and accidental. (2) Constrained association may be simply studied in the same two ways; a special experiment is devoted to abstraction (superordination). Imagination is also brought under this rubric: an elementary test consists in the presentation of words (visual or auditory) for reproduction in the reverse (literal or syllabic) order; complex tests are the building up of a sentence from a word, or of a narrative from a phrase, and the description of a picture. Ch. iii. advances to the measurement of logical phenomena. (1) Understanding is tested by the time required for the solution of a very simple geometrical problem. (2) Judgment is tested, ingeniously, by the presentation to the subject of sentences or pictures, some of which are reasonable and others absurd; the element of improbability is to be indicated. (3) Reasoning is tested by the characterisation of completed syllogisms as correct or incorrect, and by the drawing of a conclusion from presented premises. (4) Ingenuity is tested by a puzzle (arrangement of blocks).

Pt. V. is entitled "Determination of the Individual Synthesis." Ch. i., written in collaboration with Dr. M. Mignard, treats of voluntary control, *i. e.*, of the synthesis and direction, in the concrete case, of the elementary functions already measured. The apparatus used for the reaction experiment is employed to determine starting-times (action), stopping-times (inhibition) and times of change (decision); the actions called for are simple,—tapping, continuous addition or subtraction, etc. Mental stability is tested by the performance of experiments under various forms of distraction. Finally, the extent of the field of attention is measured by the assignment of a twofold instruction (alternate types of constrained association; addition and counting metronome beats), and the comparison of the results with those of the corresponding regular experiments. Ch. ii. discusses functional correlations and the comparison of individuals. It is impossible, if we start out with the tests, to reach a general measure of character or ability, or to determine the aptitude of the subjects for special vocations. On the other hand, we may start out with subjects of known ability or disability, and by examining them may be able to establish a norm of test-performance; or with any selected group of individuals, whom we may rank in the order of their standing under some particular test. These partial comparisons involve a comprehension of the nature of averages, deviations, and formulas of correlation, to which accordingly the main body of the chapter is devoted. Ch. iii. then takes up the rôle of observation in the determination of individual type. The peculiarly social side of human nature is beyond the reach of experiment; we cannot study our fellow-men as we can study animals, under the all-inclusive rubric of behavior. Even if we have at our disposal the backward forms of civilised mentality, or specimens of the backward races, a measurement of total human capacity is beyond our reach; subjective estimation must still play a part. Indeed, a field will always remain, in psychology, for

observation: individual acquisition, the intellectual sentiments, automatic and affective tendencies, the forms and degrees of self-control,—topics of this kind can be approached only by the observational method, which “deserves a kind of *technique* of its own.” Whether the authors intend to write this supplementary manual, as Dr. Hallion has undertaken to write upon physiological psychology, we are not informed; but the book is advertised to appear in the series.

E. B. T.